Agronomical efficiency of two Wheat (*Triticum aestivum* L.) Varieties against different level of Nitrogen fertilizer in Subtropical region of Pakistan

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***Abstract*—** *A field study was carried out to at Agriculture Research Institute, Sindh Agriculture University Tandojam, to investigate the effect of various nitrogen levels on growth and yield contributing traits of two wheat varieties. Wheat varieties Benazir and TJ-83 were evaluated against four nitrogen levels (0, 90, 120 and 150 kg ha^{-1}).The results revealed that the effect of nitrogen levels as well as varieties differed significantly for all the growth and yield contributing traits and N @ 150 kg ha^{-1} resulted in maximum values for plant height (87.66 cm), number of tillers m^{-2} (265.17), spike length (13.05 cm), number of spikelets spike^{-1} (22.02), number of grain spike^{-1} (68.21), seed index (48.80 g) and grain yield (4320 kg ha^{-1}). In varieties, Benazir showed its superiority over its companion variety with 82.91 cm plant height, 224.17 tillers m^{-2}, 10.52 cm spike length, 18.21 spikelets spike^{-1}, 53.00 grains spike^{-1}, 45.29 g seed index and 3649.50 kg ha^{-1} grain yield. The commercial variety TJ-83 ranked 2nd with 78.33 cm plant height, 207.75 tillers m^{-2}, 11.42 cm spike length, 19.82 spikelets spike^{-1}, 57.31 grains spike^{-1}, 40.98 g seed index and 3143.20 kg ha^{-1} grain yield. It was observed that treatment interaction N @150 kg × variety Benazir proved to be effective treatment and variety combination for achieving higher wheat yields; while, variety Benazir showed its genetic superiority yielding higher than its companion variety TJ-83.*

Keywords*— *Growth parameters, grain yield, Nitrogen, wheat.

I. INTRODUCTION

Wheat (*Triticum aestivum* L.), cultivated worldwide is the principal source of human diet with prominent position among cereals [1] particularly in the Asia and more specifically in the south Asian region supplying 68 percent of the calories and protein in the diet [2].Wheat flour is used for leavened, flat and steamed breads as well as most of the baked products [3]. The daily diet of people in Pakistan is mainly based on wheat [4].Importance of wheat in Pakistan can be noted from the fact that agricultural policies are formulated focusing this crop; 60 percent of daily diet of common man is based on wheat with average per capita consumption of 125 kg [5].

Pakistan is known to be the most important country where wheat is cultivated extensively in its all ecological conditions and included in world top ten wheat producing countries [6] but the average yields are much lower than other major wheat growing countries including China, USA, and India etc. [7]. Wheat is the leading food grain of Pakistan and occupies the largest area under single crop and contributes 10.0 percent to the value added in agriculture and 2.1 percent to GDP. Area under wheat has decreased to 9180 thousand hectares in 2014-15 from last year's area of 9199 thousand hectares which shows a decrease of 0.2 percent. The production of wheat stood at 25.478 million tons during 2014-15, showing a decrease of 1.9 percent over the last year's production of 25.979 million tons [8].Grain yield per unit area of wheat achieved in the country is still far less than the advanced wheat growing countries of the world. The low yield is attributable to many factors that include various agronomic factors [9] such as improper inputs application [10, 11]. Besides its tremendous significance, average yield is far below than developed countries [12]. Nutrient deficiency is one of the important factors.

The universal deficiency of N has become more severe in regions of continuous cropping [13]. Nitrogen is essential element of bio-molecules (amino acids, proteins, nucleic acids, phytohormones and enzymes and coenzymes). N stimulates growth, expands crop canopy and interception solar radiation [14].Plants are surrounded by the N in atmosphere; and every acre of the earth's surface is covered by thousands of pounds of nitrogen [15].Varieties and fertilizers are two dominant factors which greatly influence the yield. Introduction of new wheat varieties has not only raised the production, but also the standard of down trodden farmers. New varieties are more responsive to fertilizer than older ones and resistant to lodging. Nitrogen plays an important role in boosting up the yield when used in an appropriate amount. The studies carried out earlier indicated that highest wheat grain yield (4293 kg ha^{-1}) was recorded with application of 150 kg N ha^{-1}[16, 17]. A linear increase in wheat grain and straw yield with additive dose of N fertilizer up to 120 kg N ha^{-1}[18].The high wheat yield can sustainably be achieved with application of N fertilizer in addition to P and K at optimum rates. The recommended dose 120kg P ha^{-1} for achieving higher grain yield, nutrient uptake, spike number and grains $spike^{-1}$[19]. The highest wheat yields when the crop was fertilized with 90 kg of N ha^{-1}. The use of mineral fertilizers is beneficial for increasing the soil fertilizer status and crop productivity and 80-120 kg N ha^{-1} fertilization in wheat for achieving higher yields [20]. Nitrogen upto 180 kg ha^{-1} in addition to P, at 120 kg ha^{-1} for achieving higher yields in different wheat varieties [21]. Recommended dose of 200 kg N ha^{-1} compared to dose of 150 kg N ha^{-1} for increased grain yield [22]. Nitrogen at the rate of 200 kg ha^{-1} resulted in maximum crop performance for height of plants, leaves $plant^{-1}$,tillers, earhead length, matter yield, grains $earhead^{-1}$, spikelets $earhead^{-1}$and biological yield [23]. In view of the facts stated above, the experiment was performed to identify the optimum nitrogen requirement of two wheat varieties under agro-ecological conditions of Tandojamto assess the growth and yield response of different wheat varieties to different levels of nitrogen and to find out wheat variety with enhanced yield potential and optimum Nitrogen use.

II. MATERIALS AND METHODS

In order to evaluate nitrogen requirement of wheat varieties, the study was carried out during the year 2014-15 at the experimental fields of Plant Physiology Section, Agriculture Research Institute, Tandojam. Split plot design was used for laying out this experiment with three replicates in a split size of 4 x 3 m (12 m^2). The details of treatments are given as under:

2.1 Layout plan of the experiment

Experimental design: Split Plot Design (SPD)

Replications: Three

Net plot size: 4 m x 3 m (12 m^2)

Treatments Two Factor = A and B

Factor = A

Main plot (Varieties) = 02 V_1 = Benazir

V_2 = TJ- 83

Factor = B

Sub-plot (Nitrogen levels) = 04

N_1 = Control (0 kg N ha^{-1})

N_2 = 90 kg N ha^{-1}

N_3 = 120 kg N ha^{-1}

N_4= 150 kg N ha^{-1}.The cultural practices generally recommended were adopted uniformly in all the experimental units. The details are given as under:

2.2 Land preparation

The land was prepared by giving two dry plowings, followed by land leveling. After soaking dose when land came in condition, it was plowed crosswise with cultivator, followed by rotavator and planking for achieving a good seedbed.

2.3 Sowing time and method

The seed of wheat variety T.J-83 at recommended rate of 125 kg $ha^{-1}$was sown with single row hand drill in the 1st week of November, 2012 maintaining row to row distance of 22.5cm.

2.4 Irrigation and fertilizer application

The first irrigation was applied at the crown root initiation stage i.e. 21 days after sowing; subsequent irrigations were applied as and when it was needed until the crop reached physiological maturity. In all six irrigations were applied. All Phosphorus (in the form of Single Super Phosphate) and 1/3rd of N was applied at the time of sowing, and remaining 1/3rd of N at 1st irrigation and 1/3rd of N was applied at 2nd irrigation in the form of urea.

2.5 Weeding

All narrow leaf and broad leaf weeds were controlled by applying suitable post-emergence herbicides recommended for wheat crop.

2.6 Crop harvesting and threshing

At maturity five plants from each treatment of all replications was selected at random for harvest. These plants were harvested by cutting at soil level with sickle. The earheads were separated from straw, placed in separate paper bags, oven-dried for 24 hours at 78°C and threshing was carried out manually. The observations were recorded on the following parameters:

a) Plant height (cm)

b) Number of tillers m^{-2}

c) Spike length (cm)

d) Number of spikelets $spike^{-1}$

e) Number of grain $spike^{-1}$

f) Seed index (1000 grain weight, g)

g) Grain yield (kg ha^{-1})

2.7 Procedure for recording observations

2.7.1 Plant height (cm)

Plant height was recorded at maturity of the crop in randomly selected plants using measuring tape from bottom to tip of the spike in centimeters.

2.7.2 Tillers m^{-2}

Total number of tillers in a square area of one meter was counted at the time of maturity in each plot and averaged.

2.7.3 Spike length (cm)

The length of all the spikes in randomly selected plants was measured in centimeters with measuring tape and average was worked out.

2.7.4 Number of spikelet's $spike^{-1}$

The number of spikelets in each spike of the randomly selected plants was counted at the crop maturity and average was worked out.

2.7.5 Number of $spike^{-1}$

The number of grains $spike^{-1}$ in each of the randomly selected plants was counted at the crop maturity and average was calculated.

2.7.6 Seed index

One thousand grains from each plot were collected at random and weighed to record the seed index in grams.

2.7.7 Grain yield ha^{-1}

The grain received from each plot was weighed and on the basis of grain yield plot^{-1}, grain yield ha^{-1} was calculated in kilograms using the following formula:

$$Yield\ ha-1=\frac{Grain\ yield\ plot-1(kg)}{Plot\ area\ (m-2)}\times 10000$$

2.8 Statistical analysis

The collected data were subjected to statistical analysis to analyze the variance in treatment means. L.S.D (Least Significant Difference) test was applied to observe the statistical differences within treatments following the method developed by [24].

III. RESULTS AND DISCUSSION

3.1 Result

The study was carried out during 2014-15 to assess nitrogen requirement of two wheat varieties (Benazir and TJ-83) examining four nitrogen levels (0, 90, 120 and 150 kg ha^{-1}). The wheat varieties were considered as main plot, while the sub-plots were the nitrogen levels in split plot design. Plant height, number of tillers m^{-2}, spike length, number of spikelets spike^{-1}, number of grain spike^{-1}, seed index (1000 grain weight) and grain yield were the traits of economicimportance included in this experiment; and the data on these traits are produced in **Tables 1.**

3.1.1 Plant height (cm)

The plant height of wheat varies among varieties and this trait is generally associated with the genetic make of varieties. The optimum nitrogen requirement of wheat varieties in relation to their plant height was examined and the results are shown in **Table1**. The analysis of variance indicated that effect of varying nitrogen levels and varieties on plant height of wheat was significant ($P<0.05$); while non-significant for treatment interaction between nitrogen levels × varieties ($P>0.05$). The nitrogen @ 150 kg ha^{-1} resulted in tallest plants on average (87.66 cm); while height of the plants followed a declining trend i.e. 85.33 cm and 80.66 cm with decreasing nitrogen levels upto 120 kg ha^{-1} and 90 kg ha^{-1}, respectively. The wheat plants of minimum height (69.83 cm) recorded in plots kept untreated of nitrogen (control). Similarly, wheat variety Benazir produced plants of maximum height (82.91 cm); while variety TJ-83 produced plants of minimum height (78.83 cm). Treatment interaction of N @150 kg ha^{-1} × Variety Benazir produced plants of maximum height (89.33 cm); while interaction of N Control× Variety TJ-83 produced plants of minimum height (68.66 cm). It was observed that increasing N levels linearly increased the plant height, regardless the varieties.

3.1.2 Number of tillers m^{-2}

The tillering capacity in wheat is very important trait and varieties with higher tillering capacity produce higher grain yields. The effect of different nitrogen doses on the tillers m^{-2} of two wheat varieties was investigated and the data are presented in **Table 1**. The analysis of variance showed that tillers m^{-2} of wheat were significantly ($P<0.05$) affected by nitrogen levels and varieties; while interactive effect of nitrogen levels × varieties on tillers m^{-2} was non-significant ($P>0.05$). The nitrogen @ 150 kg ha^{-1} produced maximum number of tillers m^{-2} (265.17); while tillers m^{-2} decreased to 253.50 and 195.67 with decreasing nitrogen levels upto 120 kg ha^{-1} and 90 kg ha^{-1}, respectively. However, the lowest tillers m^{-2} (149.50) was obtained from the control plots where nitrogen was not applied. In case of wheat varieties, Benazir produced significantly higher number of tillers m^{-2} (224.17) as compared to variety TJ-83 (207.75 m^{-2}). Treatment interaction of N @150 kg ha^{-1} × Variety Benazir produced plants of highest number of tillers m^{-2} (270.00); while interaction of N Control× Variety TJ-83 produced lowest number of tillers m^{-2} (144.00). This indicated that increase in nitrogen rate showed a simultaneous positive impact on the number of tillers m^{-2}. However, in varieties Benazir showed its genetic superiority over TJ-83 for tillering capacity.

3.1.3 Spike length (cm)

The spike length in wheat is one of the most important traits influenced by the genetic makeup of the parent material of respective varieties. The effect of various nitrogen levels on the spike length of two wheat varieties was evaluated and the results are given in **Table 1**. The analysis of variance demonstrated that spike length of wheat was significantly ($P<0.05$) influenced by rate of nitrogen application and varieties; while non-significant influence on spike length was observed due to interaction between nitrogen levels × varieties ($P>0.05$). The application of nitrogen at highest rate of 150 kg ha^{-1} resulted in longest spikes (13.05 cm); while length of the spikes followed a decreasing trend i.e. 12.33 cm and 10.17 cm with reduced

nitrogen levels upto 120 kg ha^{-1} and 90 kg ha^{-1}, respectively. The shortest spikes (8.31 cm) were recorded in plots kept untreated of nitrogen (control). Similarly, wheat variety TJ-83 produced longer spikes (11.42 cm) as compared to variety Benazir (10.52 cm). Interactive effect of N levels and varietie4s showed that interaction of N @150 kg ha^{-1} × Variety TJ-83 resulted in longest spikes (13.50 cm); while interaction of N Control× Variety Benazir resulted in shortest spikes (7.88 cm). Irrespective of varieties, there was linear impact of increasing nitrogen levels on the spike length of wheat. However, variety TJ-83 was genetically superior line over Benazir so far the spike length is concerned.

3.1.4 Number of spikelets spike^{-1}

The effect of different nitrogen levels on the number of spikelets spike^{-1} of two wheat varieties was examined and the data are shown in **Table 1**. The analysis of variance suggested that the number of spikelets spike^{-1} of wheat varieties were significantly ($P<0.05$) affected by nitrogen levels and varieties; while interactive effect of nitrogen levels × varieties on this trait was statistically non-significant ($P>0.05$). The nitrogen @ 150 kg ha^{-1} produced maximum number of spikelets spike^{-1} (22.02); while spikelets spike^{-1} reduced to 21.15 and 17.95 with decreasing nitrogen levels upto 120 kg ha^{-1} and 90 kg ha^{-1}, respectively. However, the lowest spikelets spike^{-1} (14.93) were recorded in control plots where nitrogen was not applied. In case of varieties, TJ-83 resulted in significantly higher number of spikelets spike^{-1} (19.82) than variety Benazir (18.21). Treatment interaction of N @150 kg ha^{-1} × Variety TJ-83 produced highest number of spikelets spike^{-1} (23.06); while interaction of N Control× Variety Benazir resulted in lowest number of spikelets spike^{-1} (14.56). This showed that increase in nitrogen levels showed a concurrent encouraging effect on spikelets spike^{-1}. However, in varieties TJ-83 has capability to produce more spikelets spike^{-1} than Benazir.

3.1.5 Number of grains spike^{-1}

The number of grains spike^{-1} is mainly influenced by the spike length and this trait is guided by the genetic makeup of parental material of varieties. The effect of various nitrogen levels on grains spike^{-1} of two wheat varieties was determined and the results are presented in **Table 1**. The analysis of variance indicated that the number of grains spike^{-1} of wheat varieties was significantly ($P<0.05$) influenced by nitrogen levels and varieties; while nitrogen levels × varieties interaction was non-significant ($P>0.05$). It can be seen from the results that maximum number of grains spike^{-1} (68.21) was achieved in plots supplied with nitrogen @ 150 kg ha^{-1}; while grains spike^{-1} decreased slightly to 67.10 when the crop was fertilized with nitrogen @120 kg ha^{-1}; while nitrogen @ 90 kg ha^{-1} resulted in 47.14 grains spike^{-1}. However, the minimum number of grains spike^{-1} (38.17) was obtained in absence of nitrogenous fertilization (Control). In case of varieties, TJ-83 produced significantly more grains spike^{-1} (57.31) as compared to variety Benazir (53.00). Treatment interaction of N @150 kg ha^{-1} × Variety TJ-83 produced highest number of grains spike^{-1} (71.21); while interaction of N Control× Variety Benazir produced lowest number of grains spike^{-1} (37.23). It was observed that increase in nitrogen levels resulted in a linear increase in the number of grains spike^{-1}. However, statistically the differences in grains spike^{-1} between 150 and 120 kg N ha^{-1} were non-significant; suggesting 120 kg N ha^{-1} as an optimum N level for the number of grains spike^{-1} trait. However, in varieties, TJ-83 proved to be superior over Benazir in regards to number of grains spike^{-1}.

3.1.6 Seed index (1000 grains weight, g)

The seed index is a quality trait in wheat that measures the grain quality on the basis of overall weight of the grain. The influence of varying nitrogen levels on seed index of wheat varieties Benazir and TJ-83 was examined and the data are shown in **Table 1.** The analysis of variance demonstrated significant ($P<0.05$) influenced by nitrogen levels and varieties; while the interactive effect of nitrogen levels × varieties was non-significant ($P>0.05$). The results in Table 6 indicated that highest seed index (48.80 g) was recorded in crop supplied with nitrogen at the highest rate of 150 kg ha^{-1}; followed by 120 kg and 90 kg ha^{-1} N levels that resulted in average seed indexvalue of 47.14 g and 41.17 g, respectively.However, the lowest seed index value of 35.42 g was recorded in plots kept without nitrogenous fertilizer (Control). In varieties, Benazir produced bolder grains with seed index value of 45.29 g as compared to variety TJ-83 (40.98 g). Treatment interaction of N @150 kg ha^{-1} × Variety Benazir resulted in maximum seed index (50.70 g); while N Control× Variety TJ-83 produced minimum seed index(33.64). It was observed that the crop receiving higher levels of nitrogen fertilizer produced bolder grains and hence higher seed index value was obtained. Linear impact of each increased N level on seed index was observed; while among varieties, Benazir produced bolder grains than TJ-83.

3.1.7 Grain yield ha-1

The grain yield is constituted by a number of its contributing traits such as tillers plant^{-1}, grains spike^{-1}, grains weight spike^{-1} as well as seed index. The grain yield is primarily guided by the genetic makeup of varieties; but the impact of proper rate of

fertilizers is also one of the most influencing factors. The results in regards to grain yield ha^{-1} of two wheat varieties as influenced by different nitrogen levels are shown in **Table 1**. The analysis of variance showed that the grain yield ha^{-1} of wheat varieties was significantly (P<0.05) affected by nitrogen levels, varieties as well as by nitrogen levels × varieties interaction. It is obvious from the results that highest grain yield of 4320 kg ha^{-1} was achieved in plots fertilized with N @ 150 kg ha^{-1}; while grain yield decreased to 4075 kg ha^{-1} and 3076.7 kg ha^{-1} in plots receiving N @120 kg ha^{-1} and N @ 90 kg ha^{-1}, respectively. However, the lowest grain yield ha^{-1} (2113.7 kg) was obtained in plots kept untreated of N fertilizers (Control). In case of varieties, Benazir produced significantly higher grains yield of 3649.50 kg ha^{-1} than its companion variety TJ-83 (3143.20 kg ha^{-1}). Treatment interaction of N @150 kg ha^{-1} × Variety Benazir produced maximum grain yield ha^{-1} (4643.3 kg); while interaction of N Control× Variety TJ-83 resulted in lowest grain yield ha^{-1} (1989.3 kg). The grain yield increased substantially with each increment in nitrogen levels and 150 kg N ha^{-1} showed optimistic results in regards to yield ha^{-1} of wheat. Moreover, variety Benazir found to be more promising than variety TJ-83 surpassing this variety in yield by considerable margin.

TABLE 1
EFFECT OF NITROGEN LEVEL AND WHEAT VARIETIES ON GROWTH INDICES OF WHEAT PRODUCTION.

Growth index	Wheat varieties	Nitrogen level				Mean
		N1=0kgha^{-1}	N2=90kgha^{-1}	N=3120kgha^{-1}	N4=150kgha^{-1}	
Plant height (cm)	Benazir	71.00^{d}	84.00^{c}	87.33^{b}	89.33^{a}	82.91^{A}
	Tj-83	68.66^{d}	77.33^{c}	83.33^{b}	86.00^{a}	78.33^{B}
	Mean	68.66^{d}	77.33^{c}	83.33^{b}	86.00^{a}	
Number of tillers (m^{-1})	Benazir	155.00 ^{d}	211.67^{c}	260.00^{b}	270.00^{a}	224.16^{A}
	Tj-83	144.00^{d}	247.00^{b}	260.33^{a}	207.75^{c}	214.77^{B}
	Mean	149.50^{d}	229.33^{c}	260.16^{a}	238.87^{b}	
Spike length (cm)	Benazir	7.88^{c}	9.58 b	12.00 ^{a}	12.61^{a}	10.51^{A}
	Tj-83	8.73^{d}	10.77^{c}	12.67^{b}	13.5^{a}	11.41^{A}
	Mean	8.30^{d}	10.17^{c}	12.30^{b}	13.05^{a}	
Number of spikelets spike $^{-1}$	Benazir	14.56^{c}	16.96^{b}	20.33^{a}	20.98^{a}	18.20^{A}
	Tj-83	15.30$_{d}$	18.93^{c}	21.96^{b}	23.06^{a}	19.81 ^{B}
	Mean	14.93^{d}	17.94^{c}	21.14^{b}	22.02^{a}	
Number of grains spike $^{-1}$	Benazir	37.23^{d}	44.73^{c}	64.83^{b}	65.22^{a}	53.00^{B}
	Tj-83	39.10 ^{d}	49.54^{c}	69.36^{b}	71.21^{a}	57.3025^{A}
	Mean	38.16 ^{d}	47.13 ^{c}	67.09 ^{b}	68.215^{a}	
Seed Index (1000 grains weight) (g)	Benazir	37.20^{d}	44.23^{c}	48.98^{b}	50.70^{a}	45.27^{A}
	Tj-83	33.64^{c}	38.10^{b}	45.30^{a}	46.90^{a}	40.985^{B}
	Mean	35.42^{c}	41.16^{b}	47.14^{a}	48.80 ^{a}	
Grain Yield kg ha^{-1}	Benazir	2238.00 ^{d}	3226.70 ^{c}	4490.00 ^{b}	4643.00 ^{a}	3649.42^{A}
	Tj-83	1989.30 ^{d}	2926.70 ^{c}	3660.00 ^{b}	3996.70 ^{a}	3143.17^{B}
	Mean	2113.65^{d}	3076.70 ^{c}	4075.00 ^{b}	4319.85^{a}	

N= Nitrogen levels. Values are means of two determinations. Means with the different letters (superscript) are significantly different at (p<0.05).

3.2 Discussion

Due to climatic change and continuous cropping, the soils are deteriorating in essentially required nutrients and in result the desired crop yields are not obtained. Hence, it is imperative to carryout research to optimize the nitrogen requirement of crop varieties. This study was conducted to examine the effect of various nitrogen levels on wheat varieties. The study showed that N @ 150 kg ha^{-1} resulted in maximum values for plant height (87.66 cm), number of tillers m^{-2} (265.17), spike length

(13.05 cm), number of spikelets spike^{-1} (22.02), number of grain spike^{-1} (68.21), seed index (48.80 g) and grain yield (4320 kg ha^{-1}). Decreasing N rates resulted in deteriorated crop performance regardless the varieties. It was observed that treatment interaction N @150 kg × variety Benazir proved to be effective treatment and variety combination for achieving higher wheat yields; while, variety Benazir showed its genetic superiority yielding higher than its companion variety TJ-83. These results are fully supported by [25]wheat crop responded positively to the fertilization of NP in different levels and combinations; while [26]100 kg N + 60 kg P were the optimum rates for achieving higher wheat yields. The high level of crop production can be sustained with the application of N and P under an intensive cropping system provided there is no trace element deficiency [27]. Recommended dose 120-60 kg NP ha^{-1} for obtaining increased grain yield, nutrient uptake, spike number and grains spike^{-1}[28]. The effect of different rates of N and P fertilizer on wheat and observed that grain yield of wheat increased from 1984 to 2706 kg per hectare when 90 kg of N per hectare were applied [28]. The use of mineral fertilizers is beneficial for increasing the soil fertilizer status and crop productivity [29]. Application 120:60:30 kg N, P_2O_5 and K_2O ha^{-1} than at lower levels of 100:50:25 and 80:40:20 kg N, P_2O_5 and K_2O ha^{-1}[29]. Recommended 140 kg per hectare N for higher grain yield in wheat [30]; the highest wheat grain yield (4293 kg ha^{-1}) was recorded with an application of 150-100-50 kg NPK ha^{-1}[31]. 80-120 kg N ha^{-1} fertilization in wheat for higher yields [32]. Nitrogen upto 180 kg per hectare alongwith P at 120 kg per hectare respectively for achieving higher yields in different wheat varieties [33]. The recommended dose of 200 kg N ha^{-1} compared to dose of 150 kg N ha^{-1} for increased grain yield [34]. Nitrogen at the rate of 200 kg ha^{-1} produced greater plant height, leaves plant^{-1},tillers, ear length and weight, dry weight, grains ear^{-1}, spikelets ear^{-1} and biological yield. Beneficial effect of nitrogen application on wheat tillers, spikes, plant height, spike length, spike lets, grains spike^{-1}, and grain and straw yields was recorded. 168-840 kg ha^{-1} N-P was an optimum level for obtaining economically higher grain yields in wheat variety SKD-1 [35]. Wheat growth and yield traits enhanced due to application of N and P at higher levels, whereas excess rates of N could promote lodging and prologned days to maturity in wheat [36]. Optimum nitrogen rate is best done with production records under weather conditions [37]. Disproportionate N applicationduring wheat vegetative phases may cause significant reduction in yield and kernel weight. Application of 80-120 kg N ha^{-1} to wheat crop declined NO_3-N leaching loss without considerably reducingyield. The 60–95% of the grain Ncomes from the remobilization of N accumulated in shoots and roots just before anthesis [38]. However, nitrogen incorporation immediately after anthesis exhibited no effect on lodging. Theremobilized N from the vegetative organs accounts for 70–90%of the total panicle N. The higher N levels produced significantly higher effective tillers, higher number of grains per head and higher grain weight per head and ultimately significantly higher grain and straw yields [39]. The application of different levels of Nitrogen affected cereal grain yields significantly and suggested 160 kg N ha^{-1} for achieving higher grain yields [40]. N @ 168 kg ha^{-1} as an optimum level for obtaining economically higher grain yields in wheat variety SKD-1[41]. This results also suggested that Zn application at the rate of 5 kg ha^{-1} alongwith recommended dose of NPK fertilizers would be enough to fulfil soil Zn requirement for wheat variety SKD-1, because addition of 10 kg Zn ha^{-1} did not prove beneficial for any of the growth and grain yield components of SKD-1.

IV. CONCLUSIONS

It was concluded that for achieving higher wheat grain yields, the variety Benazir may be given preference over TJ-83.for all the growth and yield contributing traits and N @ 150 kg ha^{-1} resulted in maximum values for plant height, number of tillers m^{-2}, spike length ,number of spikelets spike^{-1}, number of grain spike^{-1}, seed index and grain yield (4320 kg ha^{-1}). The crop fertilized with N @ 120 kg ha^{-1} ranked 2nd and resulted in 4075.0 kg ha^{-1} grain yield. The performance of wheat crop given fertilizers with N @ 90 kg ha^{-1} deteriorated and ranked 3rd, while crop kept unfertilized (Control) ranked least for all the traits investigated. while, variety Benazir showed its genetic superiority yielding higher than its companion variety TJ-83.It was observed that the application of nitrogen fertilizers significantly enhanced the growth and yield contributing traits of all the wheat varieties tested in this experiment. Varieties and fertilizers are two dominant factors which greatly influence the yield.

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